DOCUMENT-IDENTIFIER: US 2453760 A
TITLE: Cavity resonator

OCR Scanned Text (3):
-P:.atented Nov. 16, 1948 21453 760 UNITED STATE@S PATENT OFFICE @2i453,760 CAVITY RESONATOR John C.'ScheReng, Interlaken, @N. J., assignor to Bell Telephone Laboratories,.Incorporated, New York, N. Y., a corporation of New York Application March 2, 1945, Serial N6. 580,517 5 Claims. (Cl. 178--44) 2 This invention relates to cavity resonators and more particularly to improvements in the energy transmission connections to cavity resone@ors. An object of the invention is to provide a cavity resonator with energy transmission connections which -@vill accentuate oscillations of a desired mode while discriminating against and tending to suppress those of undesired modes. Another object of the invention is to provide eireliit connections for a cylindrical cavity resonator whichwill enhance oscillations.of TEoi modes while discriminat-ing age@inst oscillations of TEii, TEim, TE2m and other transverse electric modes. An additional object of @the invention is to pro- 1.1 vide circuit connections between a wave guide and a cavity resonator which shall discriminate against oscillations of undesired TM modes. Cavity resonators serve in electrical microwave techniqu e as **selective** devices in a. rnanner some- 2) what analogous to that of tuned circuits at lower frequenc ies. However, because @of their dis- tributed reactances, large cavities are in general suscepti ble of a large number of **different** modes of oscillation. Most of these modes are eff ective 27) at frequencies ivhich may be relatively remote from a desired predetermined mode of oscillation but some may prove troublesome because **adja- cent** in frequency to the desired oscillatiops. idoreove r, in the case of oscillations in perfect circular cylindrical resonators, TEon, and TMim mode oscillations occur in pairs at identical fre- quencies , thus rendering their **separation** rather difficult. What is more, the **different** modes of oscillatio n of a cavity @esonator which occur at 35 the same resonance frequency appear to Interact so that energy dissipation by a resistance eff ective upon **one** mode of oscillation may sap energy from the other. The manner in which various modes Of OSCilla@- 40 tion interact is attributable i-n part to coupling occurrin g at the entrance by which energy is sup_ plied to the resonator. As an

illustration, svp- pose that a **pulse of radio frequency** energy is applied for **one** microsecond through a small loop 45 or turn of wire at the end of the inner conductor of a coaxial line, this turn being oriented in such a way as to **excite simultaneously** two modes of oscillatio n of the eavity, **one** mode desired and the other not. During the period of decay follow- 50 ing the **pulse,** the desired mode (the undesired also) will cause a current to flow in the loop. But the same loop by assumption is coupied to the undesired mode, and hence power ixTill -in ,generalbe.fe.dfr,omtheldesired:into.theundesired r)5 mode. Hence the factors causing damping in the undesired mode lwill contribute to tha in the desired mode. In accordance with the invention, discrimination in favor of the desired mode of oscillat4@on of a cavity resonator and,against an uiidesired mode is attained by coupling the resonator to its feed line or to its output circuit or to both by a multiple point coupling, the coupling points being so **chosen as to be in phase** agreer-rie-nt for the desired model of escillation and to be in **phase** disagreement for oscillations of @undesired modes. In this specification, transverse electric and transverse magnetic modes wiR be designated respectively as TE and TM, and in the case of right @circular cylindrical resonators the subscripts: n, m @and I will be used, referring respectively to the number of 360-degree **phase changes** in the eircumf erential direction and **180**-degree **phase changes** in the radial and length directions. Hence, TEoig mode oscillations in a right circular cylinder describe an Oscillation having a standing wave pattern such that its electric vectors are transverse to the cylinder axis-, there is no **change in phase** eircumferentially; there is a **single half**-wave **change in phase** in radial direction and there are nine halfwave **@, changes** @in the longitudinal or axial direction. In the drawing: Fig. I shows in perspective a cavity resonator involving oneembodiment of the invention; Fig. 2 is a plan view of the lower end of the structure of Mg. l@; Fig. 3 is a section:along a vertical **plane** passing through the zigzag broken line 3-3 of Fig. 2@; and ng. 4 Is @a section along.the line 4-4 of Fig. 2. 'Referring to the drawing, a cylindrical cavity resonator IC designed to operate in TEoi.9 mode is shown in Fig. 1. In order to **excite** TEol mode oscillations through the end plate I I a Plurality of coupling apertures 12 in this case four, are provided@ As shown in @ig. 2, the apertures are located at equally spaced points a@long the perimeter Gf la circle of about four-tenths the radius of the end plate, at a distance from the **center** where the electric field of the TEo, wave is strong relative to that at the circumference and **center**. These apertures in the embodiment disclosed are in the form of radially directed slots of the order of **one**-eighth inch iin length and **one** thirtyseconds inch wide. The main energy transmission.system which may serve as a - feed line for the @rmnator is a wave guide @f@4 designed to